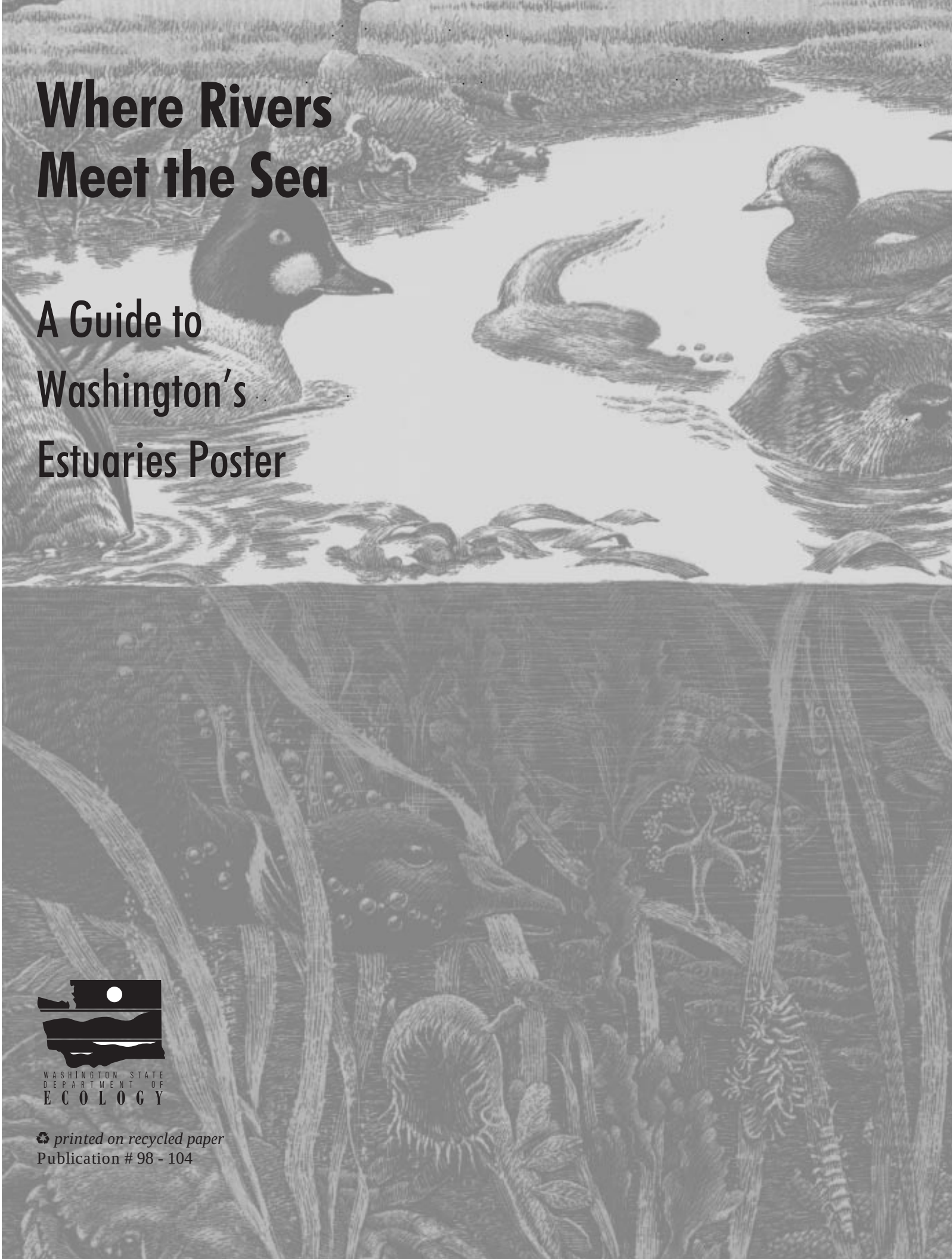

Where Rivers Meet the Sea

A Guide to Washington's Estuaries Poster

WASHINGTON STATE DEPARTMENT OF ECOLOGY

♻ *printed on recycled paper*
Publication # 98 - 104

Where Rivers Meet The Sea: A Guide to Washington's Estuaries Poster

This guide is meant to accompany the Washington State Department of Ecology's 24" X 36" Estuaries poster. The poster is one of a series illustrated by nature artist Larry Duke.

Posters are available to the general public through nonprofit organizations. For a list of distributors, visit the Department of Ecology's World Wide Web page at www.wa.gov/ecology/ under the "Shorelands & Wetlands" section; or call Ecology's Publication's Office at (360) 407-7472 and ask for Publication No. 94-151.

Public school teachers can order copies of the poster for classroom use from the Superintendent of Public Instruction's Office of Environmental Education, at (206) 365-3893.

If you would like multiple copies of this booklet, please feel free to make copies. You can download a master copy for printing from Ecology's web site at the address above. For additional single copies, call Ecology at (360) 407-7472 and ask for Publication No. 98-104.

Acknowledgements

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Padilla Bay
National Estuarine Research Reserve

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Estuaries

A tiny frozen crystal of water forms high up in the sky. It grows bigger, getting heavier until it falls to a high mountain top. In the spring the snow melts and starts a journey down the mountain into a cascade of fresh water. It travels through forests, past cities, neighborhoods, and farms until it reaches salty ocean water. This place where freshwater and saltwater mix is an estuary. In some estuaries the outgoing tide exposes mudflats - rich in dead organic matter called detritus. This is a place of productive plant growth, nursery for crabs and salmon, habitat for migrating birds and inspiration for the human spirit.

Tiny salmon, when they begin their journey to the sea, need the estuary for food and shelter. Eelgrass provides habitat for tiny crustaceans - the young salmon's favorite food - and a place to hide from predators. Because the water is part fresh and part salty, it allows the young salmon to adjust to the saltiness of ocean waters. As salmon have been threatened or in danger of extinction in Washington's waters, protecting estuaries has become even more important.

Estuaries can be found all over the world in coastal areas. Like animals, people use the estuaries in many different ways. Since the first peoples, food has been gathered at low tides and waters fished when the tide was high. Because estuaries often make protected harbors, towns like Seattle, New York, and Los Angeles have grown up there.

Estuaries are vital links to other ecosystems, connected through the flow of water and the flow of migrating animals. They filter impurities, absorb flood water, and recycle nutrients - functions that are dwindling because of human activity.

Learning more about the connections between humans and these special places we call estuaries might help us take better care of them.

This pamphlet is designed to help you learn more about the fascinating plants and animals found in estuaries. Use the key on page 2 to locate the 56 species represented on the poster. Read the interesting facts about each organism. But don't stop there! Each one of these species has a unique and intriguing life history. You can learn about these organism by watching them at estuaries, and by reading books *(see list below)*. You can use the picture in the centerfold as a coloring poster.

Find the mystery mistake

As with most projects of this type, there is a small mistake in the Estuaries poster. As you study the species, see if you can find it!
Clue: The mistake is a marking that would not be found on a living member of this species.
The answer is on the back page, but don't peek until you've done some sleuthing.

Some good books about estuaries

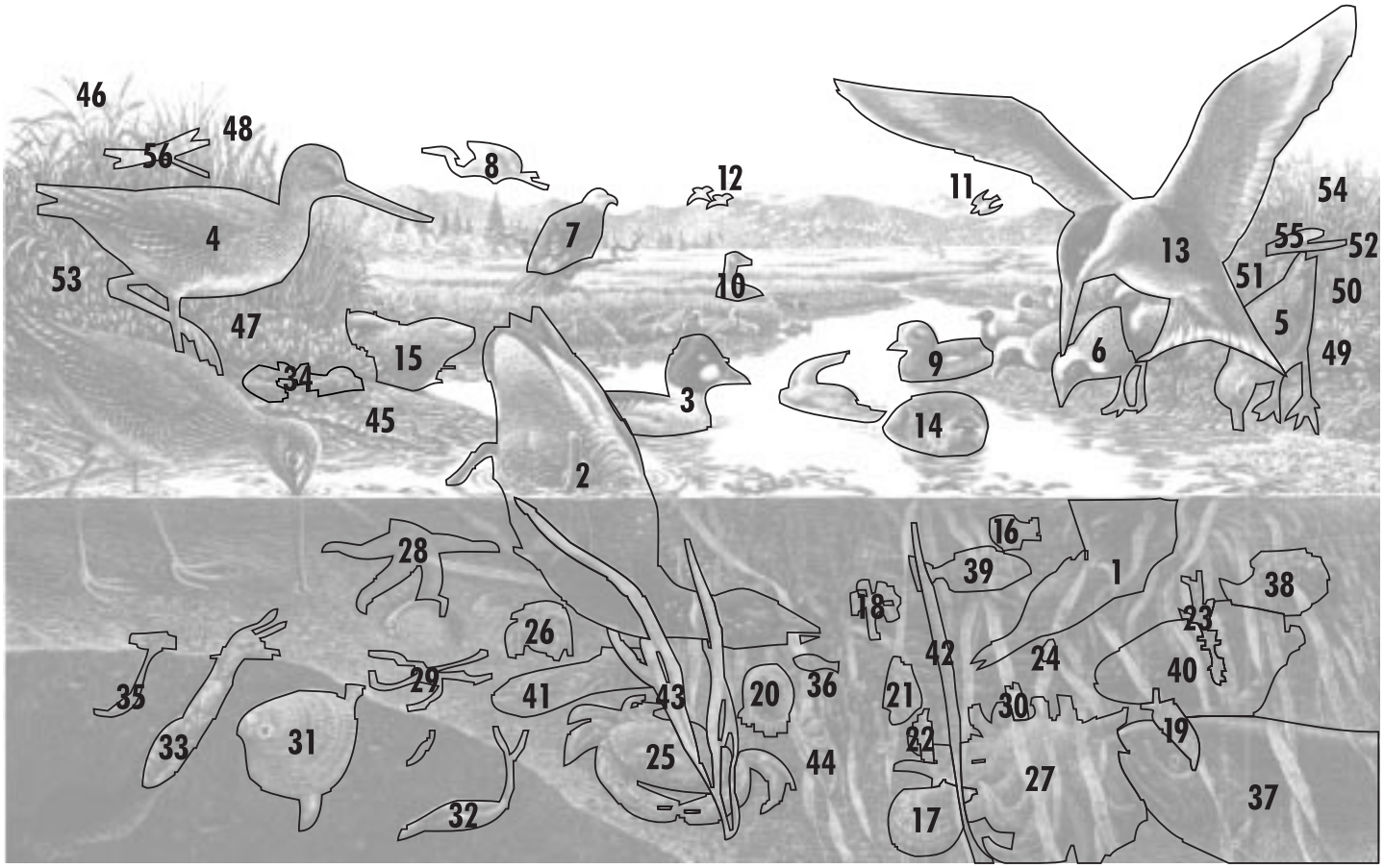
There are many excellent books about estuary life. Here are some books to help you get started as you learn about these wonderful places:

- *Marine Wildlife of Puget Sound, the San Juans, and the Strait of Georgia*, by Steve Yates
- *Exploring the Seashore*, by Gloria Snively
- *Between Pacific Tides*, by Ricketts and Calvin
- *Seashore Life of the Northern Pacific Coast*, by Eugene Kozloff
- *The Natural History of Puget Sound*, by Arthur Kruckeburg

Note: *This book uses the metric system of measurement to describe species. To translate metric numbers, multiply centimeters by .39 to find inches.*

Species List

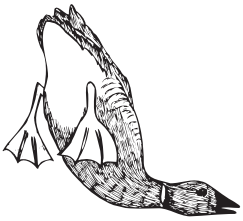
1. Red-breasted Merganser - *Mergus serrator*
2. Black Brant - *Branta bernicla*
3. Common Goldeneye - *Bucephala clangula*
4. Greater Yellowlegs - *Tringa melanoleuca*
5. Dunlin - *Calidris alpina*
6. Black-bellied Plover - *Pluvialis squatarola*
7. Bald Eagle - *Haliaeetus leucocephalus*
8. Great Blue Heron - *Ardea herodias*
9. American Wigeon - *Anas americana*
10. Canada Goose - *Branta canadensis*
11. Peregrine Falcon - *Falco peregrinus*
12. Western Sandpiper - *Calidris mauri*
13. Caspian Tern - *Sterna caspia*
14. River Otter - *Lutra canadensis*
15. Harbor Seal - *Phoca vitulina*
16. Orange Striped Jellyfish - *Gonionemus vertens*
17. Scallop - *Pecten caurinus*
18. Stalked Jellyfish - *Thaumatoscyphus hexaradiatus*
19. Opalescent Nudibranch - *Hermissenda crassicornis*
20. Hooded Nudibranch - *Melibe leonina*
21. Brooding Sea Anemone - *Epiactis prolifera*
22. Eelgrass Isopod - *Idotea resecata*
23. Skeleton Shrimp - *Caprella equilibra*
24. Chink Shell - *Lacuna variegata*
25. Dungeness Crab - *Cancer magister*
26. Hermit Crab - *Pagurus granosimanus*
27. Sunflower Star - *Pycnopodia helianthoides*
28. Blood Star - *Henricia leviuscula*
29. Long Rayed Brittle Star - *Amphiodia occidentalis*
30. Bubble Shell - *Haminoea virescens*
31. Native Littleneck Clam - *Protothaca staminea*
32. Bent-nosed Clam - *Macoma nasuta*
33. Mud Shrimp - *Upogebia pugettensis*
34. Purple Shore Crab - *Hemigrapsus nudus*
35. Lugworm - *Abarenicola pacifica*
36. Chum Salmon - *Oncorhynchus keta*
37. Chinook Salmon - *Oncorhynchus tshawytscha*
38. Pacific Spiny Lumpsucker - *Eumicrotremus orbis*
39. Shiner Perch - *Cymatogaster aggregata*
40. Starry Flounder - *Platichthys stellatus*
41. Pacific Staghorn Sculpin - *Leptocottus armatus*
42. Bay Pipefish - *Syngnathus griseolineatus*
43. Eelgrass - *Zostera marina*
44. Red Algae - *Smithora naiadum*
45. Sea Lettuce - *Ulva lactuca*
46. Lyngby's Sedge - *Carex lyngbyei*
47. Pickleweed - *Salicornia virginica*
48. Seaside Arrowgrass - *Triglochin maritimum*
49. Pacific Silverweed - *Potentilla anserina*
50. Saltgrass - *Distichlis spicata*
51. Gumweed - *Grindelia integrifolia*
52. Douglas Aster - *Aster subspicatus*
53. Fat-hen Saltbush - *Atriplex patula*
54. Tufted Hairgrass - *Deschampsia cespitosa*
55. Damsel Fly - *Argia vivida*
56. Green Darner - *Anax junius*



1. Red-breasted Merganser - *Mergus serrator*

These diving birds are common winter visitors to estuaries. One of the swiftest ducks, they rapidly swim with their head and neck stretched out in front. They eat crustaceans, molluscs and fish such as young salmon. During winter courtship, males give a cat-like call and make elaborate body movements.

2. Black Brant - *Branta bernicla*

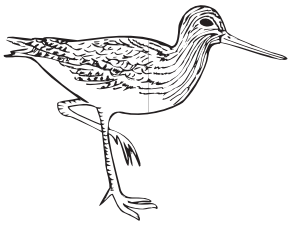


You can spot a Black Brant goose by its white neck ring and white under the tail. These birds eat eelgrass in estuaries along the Pacific Flyway. Some Brant migrate three thousand miles from Alaska to Baja, Mexico without stopping!

3. Common Goldeneye - *Bucephala clangula*

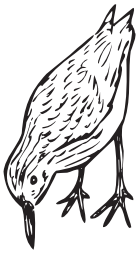
These diving birds can be found in open water looking for crustaceans and molluscs to eat. The males attract females with an interesting dance. They circle the female, bend their heads back to the tail feathers and spray water into the air with their feet.

4. Greater Yellowlegs - *Tringa melanoleuca*



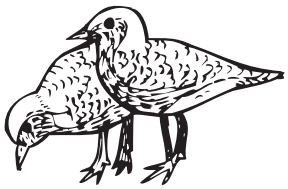
A spring and late summer visitor to Washington estuaries, this beautiful shorebird can be seen wading in shallow water, gobbling up small fish and crabs.

5. Dunlin - *Calidris alpina*



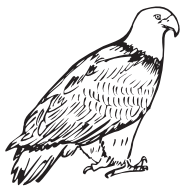
These small shorebirds can be seen on the mudflats or beach hunting for crustaceans, molluscs, worms and insects. They fly in large flocks like clouds that flash light and dark as they turn together.

6. Black-bellied Plover - *Pluvialis squatarola*



Spending summers in the Arctic tundra and winters on sandy beaches and mud flats, these shorebirds feed on worms, insects, crustaceans and molluscs. They often fly in a flock, but scatter when feeding.

7. Bald Eagle - *Haliaeetus leucocephalus*



These mighty birds can be found all year in Washington. They rest in treetops, soar with flat wings, and swoop down to the water for fish and small ducks. Young bald eagles are about five years old before they get the white head and tail feathers of adults.

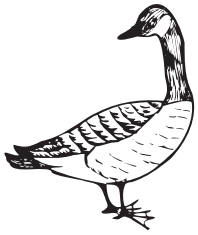
8. Great Blue Heron - *Ardea herodias*

These birds live all year in Washington. With their long legs and neck, they are specially adapted for fishing in shallow water. They eat estuary fish like perch, sculpin, starry flounder and sanddabs.

9. American Wigeon - *Anas americana*

These birds are common winter visitors to Washington estuaries where they feed on eelgrass. They pick their mates during the winter. The males compete for females by repeating whistle calls and lifting folded wings above their backs. By March most females have mates before they migrate north to nest.

10. Canada Goose - *Branta canadensis*



These migrants are found in Washington during the spring and fall. They eat plants like grasses and corn. They are fun to watch, but do not get too close. They can be quite aggressive, especially when they have young.

11. Peregrine Falcon - *Falco peregrinus*

Though these birds are found throughout the world, you would be very lucky to see one because they are very rare. With amazing speed, they catch other birds in mid-air. Occasionally they eat insects. These birds were once endangered in the United States because of the use of DDT. Populations have been recovering since this toxic chemical was banned.

12. Western Sandpiper - *Calidris mauri*

These birds have their babies in Alaska then fly thousands of miles to South America for winter. They stop in estuaries to eat along the way. With their long pointed beaks, they catch worms and shrimp-like animals. Falcons like to eat this bird.

E S T U

ARIES

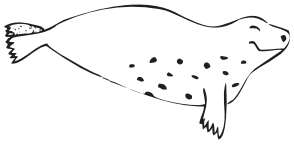
13. Caspian Tern - *Sterna caspia*

This is the largest of the terns. They fly with extreme grace. Sometimes they drop 30 feet or more into the water to catch fish. Just a few flaps of their wings gets them up again. It is fun to watch them skimming the water, quickly shifting direction as they look for food.

14. River Otter - *Lutra canadensis*

These mammals live in both fresh and saltwater. They are seen in and around the estuary and also in rivers and streams. They catch fish and crabs with their sharp teeth. Although these playful and curious mammals are mostly seen in water, they often go on land to eat and rest under rocks or tree roots.

15. Harbor Seal - *Phoca vitulina*



With their gentle eyes and spotted fur, these are the most common marine mammals in Washington. They eat many species of fish including herring, salmon, sculpin and hake. If you see them resting on shore, do not approach them. If you see a marine mammal that needs help, call 1-800-562-8832.

16. Orange Striped Jellyfish - *Gonionemus vertens*

During the summer, large numbers of orange striped jellyfish attach themselves to eelgrass and kelp with sticky pads located near the tips of their tentacles. When not attached they swim much like other jellyfish. These tiny invertebrates are only 1.5 cm across. They feed mostly on small crustaceans such as amphipods and the larvae of fishes.

17. Scallop - *Pecten caurinus*

These delicious animals are common in Puget Sound. Scallops swim through the water with a jerky motion by clapping their two shells together. Scallops have many (up to 30 or 40) tiny eyes lining the inside edges of their shells.

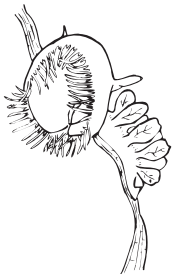
18. Stalked Jellyfish - *Thaumatoscyphus hexaradiatus*

The stalked jellyfish is an oddball that attaches itself to eelgrass and kelp. It has eight clusters of tentacles attached to a 2.5 cm stalk. The tentacles have stinging cells called nematocysts that are used to kill prey. These jellyfish are shiny green, yellow, orange, and brown.

19. Opalescent Nudibranch - *Hermissenda crassicornis*

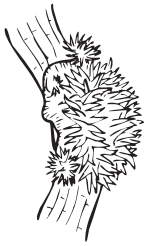
This sea slug is covered with soft, orange tipped fingers called cerrata that act like gills. A shiny blue line, like a neon light, decorates each side of its body. It eats a variety of foods including molluscs, eggs, bits of detritus, and hydroids (anemone-like animals with stinging cells). After being eaten, the stinging cells from the hydroids migrate to the cerrata where they help protect the sea slug.

20. Hooded Nudibranch - *Melibe leonina*



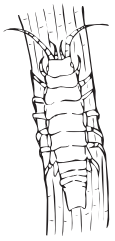
This strange looking, grayish or almost colorless nudibranch (sea slug) moves slowly around eelgrass beds catching small crustaceans with its fringed "oral hood." It grows up to 10 cm long and is able to swim using thrashing movements. It can also fill its hood with air and float to a new location.

21. Brooding Sea Anemone - *Epiactis prolifera*



This anemone is common on eelgrass blades where it feeds on plankton, small crustaceans, and detritus. It has white stripes and ranges in color from red to brown to green. After the eggs hatch in its stomach, the larvae (babies) come out its mouth and attach to its side where they grow.

22. Eelgrass Isopod - *Idotea resecata*



Even though this is one of the largest isopods (up to 5 cm), it can be hard to spot clinging to the eelgrass blades. It is camouflaged by its green color and narrow flat shape which looks like the blades of eelgrass.

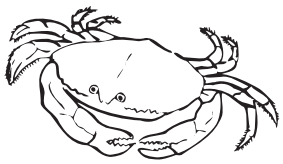
23. Skeleton Shrimp - *Caprella equilibra*

This odd looking crustacean is also called a caprellid amphipod. It clings tightly to the blades of eelgrass with its hind legs and with a "bowing" motion it uses its front legs to pick up algae, bits of detritus and hydroids. Skeleton shrimp are an important food source for young salmon.

24. Chink Shell - *Lacuna variegata*

This tiny snail "waddles" like a duck as it moves about scraping tiny plants and animals from the surface of eelgrass blades with its rough tongue. Its eggs, which look like little yellow bagels, are often seen at the tips of eelgrass blades. It is called the chink shell because it has a wide chink or groove in its shell.

25. Dungeness Crab - *Cancer magister*

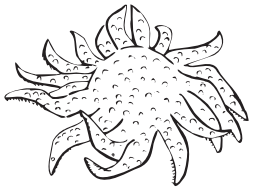


This crab can live for eight to ten years. Baby Dungeness crabs like to live in eelgrass and shallow water while adults live in deeper water. This delicious crab is worth millions of dollars in Washington as seafood.

26. Hermit Crab - *Pagurus granosimanus*

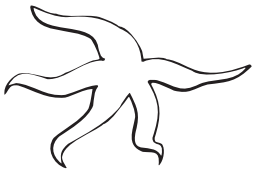
This animal can be found living in empty snail shells. The shell provides protection for its soft body. Hermit crabs are not really crabs but are related to shrimp.

27. Sunflower Star - *Pycnopodia helianthoides*



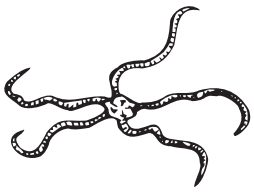
This is one of the fastest and largest of all sea stars. They can be up to a half meter across. Adults can grow as many as twenty-four legs. No wonder they move so fast.

28. Blood Star - *Henricia leviuscula*



The name of this sea star gives a hint of its bright color. It can range from tan to almost purple. It is one of the smaller sea stars - usually less than 12 cm across. It eats sponges by putting its stomach out of its mouth. When it is done feeding, it pulls its stomach back in.

29. Long Rayed Brittle Star - *Amphiodia occidentalis*

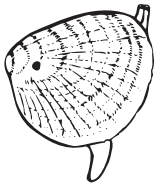


Brittle stars have very long rays (arms). Its rays can reach up to 6 cm in length, but its center disk only grows to about 6 mm across. The long-rayed brittle star lives buried in muddy sand, especially in eelgrass beds.

30. Bubble Shell - *Haminoea virescens*

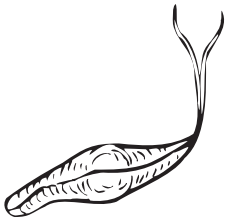
This is a small snail that looks like a slug. It has a thin shell that is much smaller than its body and foot. Its shell only reaches about 1 cm in length, but the snail's body may reach 2-3 cm. Bubble shells use their radula (rough tongue-like structure) to scrape food off eelgrass blades or off the surface of the mud.

31. Native Littleneck Clam - *Protothaca staminea*



This is probably the most important commercial food clam in the Northwest. It is oval or round in shape, and is the only clam with lines criss-crossing its shell.

32. Bent-nose Clam - *Macoma nasuta*



This clam is easily recognized by a bend in the tip of its shell. It lives in protected muddy bays. This clam can bury itself 10 to 20 centimeters in the mud. These clams live in places where there is not much oxygen.

33. Mud Shrimp - *Upogebia pugettensis*

This blue-gray shrimp lives in very muddy conditions. It digs long connecting tunnels under the mud. By fanning water through these tunnels, it feeds on detritus.

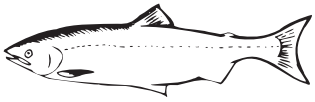
34. Purple Shore Crab - *Hemigrapsus nudus*

There are lots of these small crabs found under rocks along the shoreline. It mostly eats algae (seaweed) such as Ulva. This shore crab has a reddish tint with purple markings on the ends of its claws. Its relative,the green shore crab (Hemigraspus oregonensis), is usually a grayish green.

35. Lugworm - *Abarenicola pacifica*

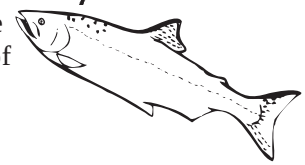
These worms are easy to locate because they leave little squiggly piles on the surface of the mud. The lugworm lives just below the piles in a J- shaped hole. Like an earthworm in a garden, a lugworm eats the dead stuff and helps turn it into good rich mud.

36. Chum Salmon - *Oncorhynchus keta*



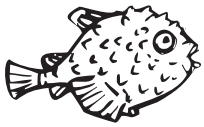
On their way to the ocean from rivers, juvenile Chum spend 4-8 weeks in the estuary feeding on tiny animals and adjusting to salt water. People are concerned about the decreasing numbers of Chum salmon in the state of Washington. It is a species that is being monitored by the National Marine Fisheries Service and citizen action groups to make sure it does not become extinct.

37. Chinook Salmon - *Oncorhynchus tshawytscha*



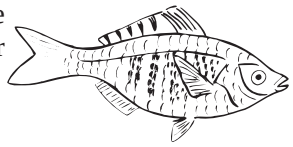
Chinook are the largest of the Pacific salmon and can weigh up to 145 pounds. They are named after the Chinook Indians, who depended on the return of the salmon to the Columbia River each year. Due to habitat loss and overfishing, the number of Chinook salmon has declined dangerously in recent years. To keep the salmon from becoming extinct salmon habitat is being restored and protected and the number fished has been regulated.

38. Pacific Spiny Lumpsucker - *Eumicrotremus orbis*



This funny little fish looks like a small puffer fish. It attaches to rocks by using a sucker on its underside. It grows to about 12 cm, and eats small animals.

39. Shiner Perch - *Cymatogaster aggregata*



Shiners have a silver color and are 10 to 13 centimeters long. They feed on skeleton shrimp and crustaceans that live on the eelgrass blades. They often move to deeper water in the winter.

40. Starry Flounder - *Platichthys stellatus*

This flat fish swims along the mud flat eating crustaceans, worms, and small fish. A flounder is born with an eye on each side of its head. After about two weeks, one eye begins to move to the other side of its face. The fish lives on the bottom of the bay with both eyes on top.

41. Pacific Staghorn Sculpin - *Leptocottus armatus*

Sculpin can be recognized by their wide heads and large side fins. They sit on the muddy bottom of the bay waiting for food to come to them. Sometimes, they get stuck on the mud flat at low tide. When this happens, they bury themselves in the mud and wait for the next high tide.

42. Bay Pipefish - *Syngnathus griseolineatus*

A relative of the sea horse, the pipefish has a stiff, narrow body with a long "snout." Its color can vary from green to brown to match its surroundings, and it often swims up and down to look like the swaying motion of eelgrass. The pipefish eats small crustaceans by sucking them into its mouth like a vacuum.

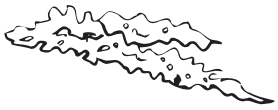
43. Eelgrass - *Zostera marina*

This is the most important plant in the estuary. It has grass-like leaves, and roots in the muddy bottom. It can grow up to two meters long. Many animals use the eelgrass to hide from predators and for a place to lay their eggs.

44. Red Algae - *Smithora naiadum*

This algae attaches to the eelgrass found in estuaries. It grows the most in the spring and summer. This type of red algae is one cell-layer thick. It can be identified by its purplish-red color.

45. Sea Lettuce - *Ulva lactuca*



This bright green algae is a common species in the intertidal region of estuaries. It is two cell-layers thick and transparent. It plays a major role in the food web as food for grazing animals.

46. Lyngby's Sedge - *Carex lyngbyei*

This common wetland plant of the Pacific Northwest is found in low and high marsh areas of estuaries. It grows to about one meter tall. When found in intertidal areas, the above-ground part of the plant dies back during the winter.

47. Pickleweed - *Salicornia virginica*

This plant has round, fleshy stems with tiny yellow flowers clustered at the tips. It is most common in low salt marshes. During winter, its fleshy growth is lost and it becomes a tangle of woody stems.

48. Seaside Arrowgrass - *Triglochin maritimum*

This salt marsh plant is usually found in areas covered by the tide twice a day. Many tiny, green or purple flowers are clustered along the upper part of the stalk. Seaside arrowgrass does not show in the winter. The upper part of this plant is removed by winter tides.

49. Pacific Silverweed - *Potentilla anserina*

Shiny, yellow flowers can be seen on this high salt marsh plant. It is a low-growing plant with serrated leaf edges resembling the strawberry plant. The undersides of the leaves are silver. This plant can be found in non-wetland habitats if it is in an area that has been diked.

50. Saltgrass - *Distichlis spicata*

This hearty plant can be found in high and low salt marsh areas. It can withstand high salinities by excreting the salt out through the leaves. Salt crystals can often be seen on the surface of the leaves. Saltgrass is usually less than 30 centimeters tall and often grows in thick mats.

51. Gumweed - *Grindelia integrifolia*

This plant is easy to identify. The entire plant is sticky to touch. It produces yellow sunflower-like flowers. Unopened flower buds have scaley, gummy coverings.

52. Douglas Aster - *Aster subspicatus*

This is a very showy wildflower with distinctive purple rays and yellow centers. The stem is stiff and fibrous, nearly woody at the base. It resides high in the tidal marshes.

53. Fat-hen Saltbush - *Atriplex patula*

This plant is seen in drier areas of coastal salt marshes. Some of its leaves are similar in shape to arrowheads. It is unique in that it has distinct male and female flowers growing on the same plant. This annual grows to be about 40 centimeters tall.

54. Tufted Hairgrass - *Deschampsia cespitosa*

This is the tallest plant of the salt marsh. It grows in thick patches at or near the high tide line. As a perennial, it lives year round turning from green in summer to a golden brown in fall and winter.

55. Damsel Fly - *Argia vivida*

Related to the dragonfly, this winged insect can be found in and around wetlands. One way to distinguish this insect from its close relatives is by the parallel position of its wings to the body when it is at rest. Attacking its prey in flight, the damsel fly feeds on other insects. These creatures need freshwater habitat to lay their eggs.

56. Green Darner - *Anax junius*

This insect is related to the dragonfly and damsel fly. Green darners gather together in the fall and spring in and around wetlands. Although most of the adults can be seen close to water, they may travel a mile or more to pastures in search of insects to eat.

Answer to mystery mistake:
The hole in the shell of the Native Littleneck Clam (#31) would have been made by a predatory snail. The snail drills a hole through the shell and sucks out the meat. In real life, this clam would be dead.